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THE EFFECT OF X-RAY ON THE RESISTANCE TO
CANCER IN MICE¹

It has been shown in previous communications that the resistance to heteroplastic tissue grafts apparently depends on the activity of the lymphocyte. The facts on which this conclusion is based are briefly as follows: The chick embryo, which normally lacks the ability to destroy a heteroplastic tissue graft, if supplied with a bit of adult lymphoid tissue, becomes as resistant as the adult in this respect. Furthermore, an adult animal deprived of the major portion of its lymphoid system by repeated small doses of X-ray, no longer has the power to destroy a graft of foreign tissue, and this tissue will grow actively. The chief characteristic of a failing heteroplastic graft in the unsuitable host is a marked local accumulation of lymphocytes. The histological picture is identical in a failing cancer graft in an immune animal of the same species. Synchronous with the establishment of the cancer immunity and during the period in which the lymphocytes are accumulating around the cancer graft, there is a lymphocytic crisis in the circulating blood. This is found in the actively immunized animals as well as in those possessing a natural immunity, but is totally lacking in animals susceptible to the cancer graft. If the lymphoid crisis be prevented in immune animals by a previous destruction of the lymphoid elements with X-ray the potentially immune animal is changed to a susceptible one.

We have noted that while repeated exposures to X-ray will destroy the lymphoid elements of an animal, one small dose will stimulate these same cells. With this artificial method of producing a lymphocytosis we have attempted to study the relation of this condition to the resistance of mice to their own spontaneous tumors. For evident reasons it was necessary to rule out the complicated question of the direct effect of X-ray on the

cancer. In order to do this we have removed the cancer at operation, and with the cancer out the animal has been subjected to a stimulating dose of X-ray. Immediately after this a graft of the original tumor was replaced in the groin of the animal. As a control the same procedure was carried out, but with X-ray treatment omitted. As a further check to the results cancers were removed from a number of animals and in this set the cancers were exposed directly to the same amount of X-ray that the animals in the first group had received. After this a graft of the tumor was returned to the original host.

The results of these three experiments are to be judged by two criteria. First, whether or not there is a return of the disease, either at the site of removal of the cancer, or at the point of inoculation of the returned graft; and second, the time at which the returned graft starts in active growth, if at all. The figures on these points are given in the following table.

	Immune Per Cent.	Suscep- tible Per Cent.	Local Recurrence of Tumor Per Cent.	Average Time for Appearance of Graft.
Series I . . .	50.0	50.0	21.2	5 wks. and 4 days.
Series II . .	3.4	96.6	48.3	1 wk. and 5 days.
Series III. .	0.0	100.0	40.0	1 wk. and 3 days.

Series I. was composed of 52 animals treated by X-ray while the cancer was outside of the body, with later a return of a graft of the tumor. Series II. was made up of 29 control animals in which the cancer was removed and a graft returned without treatment to either animal or tumor. Series III. was made up of ten animals from which the cancer was removed and the cancer subjected directly to the same amount of X-ray that the animals received in the first series, and later a graft of this X-rayed cancer returned to its original host.

It will be seen from these figures that an X-ray dose which produced a lymphocytosis when administered direct to the animal was sufficient to render 50 per cent. of the mice so treated immune to a returned graft of their

¹ From the Laboratories of The Rockefeller Institute for Medical Research. Abstract of paper presented at the New York meeting of the National Academy of Sciences.

own tumor, and in the other 50 per cent. greatly to retard the return of the disease. A similar dose of X-ray given to the cancer direct outside of the body did not influence the subsequent growth of a graft of this tumor when returned to its original host. The contrast between these figures and those of the control series is striking, as is also the number of local recurrences in the two series. If this pronounced result is obtained with one stimulating dose it is probable that a more pronounced effect might be obtained by a second exposure to X-ray after a suitable interval.

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SOCIETIES AND ACADEMIES

THE BIOLOGICAL SOCIETY OF WASHINGTON

THE 543d meeting of the society was held in the Assembly Hall of the Cosmos Club, Saturday, October 23, 1915, called to order by President Bartsch at 8 P.M., with 85 persons present.

Under the heading Brief Notes: Dr. C. W. Stiles recorded observations on blood examinations (cell counts, hemoglobin, etc.) of 600 children, between 6 and 17 years of age, in North Carolina. Dr. Stiles also made remarks on the International List of generic names of birds.

Under heading Exhibition of Specimens: Dr. J. N. Rose showed some interesting examples of humming-birds' nests which he had collected in Brazil the past summer.

The first paper on the regular program was by Professor A. S. Hitchcock, "Collecting Grasses in the Southwest." Professor Hitchcock spoke of his trip during the summer in the region from California to west Texas for the purpose of collecting grasses.

At Grand Canyon was found the rare *Stipa arida* Jones. At Ft. Bragg, Calif., was found *Agrostis breviculmis* Hitchc., known only from this locality and the western coast of South America. It is abundant on the open ground back of the sandy clay cliffs at this point. In a springy place on the side of the cliffs there was a colony of *Phleum alpinum* L., a grass of the high mountains of California. Its occurrence at sea level was very unexpected. At various points in northern California occurs *Danthonia americana* and *D. californica*. In these species the culms disarticulate near the base at maturity. An examination of the

swollen base of the detached culms discloses, hidden beneath the sheath and prophyllum, a cleistogamous spikelet consisting of a single floret. The floret and enclosed caryopsis are much larger than those of the panicle.

Cleveland Natural Forest, lying east of San Diego, was visited to investigate *Calamagrostis densa* Vasey. This species known only from the type collection by Orcutt was provisionally united with *C. koelerioides*, by the speaker,¹ but he is now satisfied that the two are distinct species.

An ascent was made of Humphreys Peak of the San Francisco Mountains, near Flagstaff, Arizona. These are the highest mountains in Arizona, the peaks extending above timber line. In the alpine region four species of grasses were found, *Trisetum spicatum*, *Poa rupicola*, *Festuca brachyphylla* and *Agropyron scribneri*. Collections were made at several other places of interest: Oracle, about 45 miles north of Tucson, in company with Professor J. J. Thornber; Big Spring, Alpine and Del Rio, in western Texas; and the Guadalupe Mountains of southern New Mexico, especially rich in Mexican species. Professor Hitchcock's paper was discussed by the chair.

The second and last paper of the program was by R. L. Garner, "African Studies; Things in Common Among Men, Apes and Other Mammals." Mr. Garner spoke of the courtship, family life, period of infancy, arrival of puberty, instincts, homes, habits and moral traits of the African anthropoid apes as observed by him in their wild state, during many years of observation in Africa. Among other things he stated that the period of gestation was probably seven months; that the young ape was born with usually 4 teeth present, twin births are exceedingly rare, the female becomes sexually mature at from 7 to 9 years, and the male from 1 to 2 years later, the usual length of life is 20 to 21 years; that their foods are mainly vegetable, but that flesh is an essential part of their diet; that they have no permanent homes, but travel about as nomadic families; that their sleeping position is on their back or side like that of men, they often make their beds 18 to 25 feet off the ground, but the young are delivered in a bed on the ground in a well-drained place; that sight and particularly hearing are acute, but that smell is not much more developed than in man and touch is less acute than in man; that the right of ownership among them is well respected. Mr. Garner concluded by saying he

¹ In Jepson, "Flora of California," 3: 125. 1912.